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Mathematics

9709/12

Paper 1 Pure Mathematics 1

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Question No (2)

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- 2 The coefficient of x^4 in the expansion of $(x+a)^6$ is p and the coefficient of x^2 in the expansion of $(ax+3)^4$ is q . It is given that $p+q=276$.

Find the possible values of the constant a .

Solution:

$$\text{Binomial formula}$$

$$(a+b)^n = \binom{n}{0} a^{n-0} b^0 + \binom{n}{1} a^{n-1} b^1 + \binom{n}{2} a^{n-2} b^2 + \dots + \binom{n}{n} a^{n-n} b^n$$

Applying the binomial formula for $(x+a)^6$,

$$(x+a)^6 = \binom{6}{0} x^6 (a)^0 + \binom{6}{1} x^5 (a)^1 + \binom{6}{2} x^4 (a)^2 + \dots + \binom{6}{6} (x)^0 (a)^6$$

From the observation of the above expansion $\binom{6}{2} (x)^4 (a)^2$ has term x^4 or coefficient.

$$\binom{6}{2} (x)^4 (a)^2 = \frac{6 \times 5}{2 \times 1} x^4 (a^2)$$

$$= 15a^2 x^4$$

$$\Rightarrow p = 15a^2 \text{ (as coefficient of } x^4 \text{ is } p)$$

Applying binomial formula for $(ax+3)^4$, we have

$$(ax+3)^4 = \binom{4}{0} (ax)^4 (3)^0 + \binom{4}{1} (ax)^3 (3)^1 + \binom{4}{2} (ax)^2 (3)^2 + \dots + \binom{4}{4} (ax)^0 (3)^4$$

From above expansion term containing x^2 , coefficient

$$\binom{4}{2} (ax)^{4-2} (3)^2 = \frac{4 \times 3}{2 \times 1} (ax)^2 (9)$$

$$= 54a^2 x^2$$

$$\Rightarrow q = 54a^2 \quad (\text{as given condition coefficient of } x^2 \text{ is } q)$$

$$\text{As } p + q = 276 \quad (\text{given})$$

$$\Rightarrow 15a^2 + 54a^2 = 276 \quad (\text{by putting values of } p \text{ and } q)$$

$$69a^2 = 276$$

$$a^2 = \frac{276}{69} = 4$$

$$a^2 = 4$$

$$a = \pm 2$$